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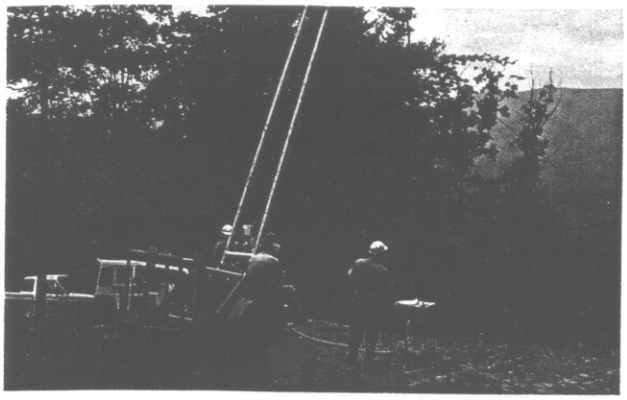

FROM FUELWOOD HARVESTS WITH CONVENTIONAL GROUND SYSTEMS AND A CABLE MINIYARDER

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INTRODUCTION

Industries, institutions, and homeowners have all substantially increased their use of fuelwood since the oil embargo of a decade ago. The potential for fuelwood production in north Georgia and the rest of the Southern Appalachians is especially great because forests there include large inventories of hardwoods that are too low in quality for conventional wood products. Multiple benefits should result from utilization of these low-grade hardwoods for fuel. Fuelwood production could boost depressed local economies and upgrade forest stands for the production of both conventional products and fuel. Two of the primary factors that currently limit utilization of low-quality mountain hardwoods for fuel are harvesting costs and potential site degradation. This paper focuses on potential site degradation associated with mountain logging.

Site degradation is patently unacceptable for the maintenance of a sustained, productive forest. Obvious erosion and sedimentation can also devalue real estate and depress economies, particularly in a region so dependent on recreation, tourism, vacation homesites, and retirement homes. This paper presents three case studies of site disturbance from fuelwood harvesting. The studies were conducted on two areas. On one area a rubber-tired cable skidder was used to remove essentially all of the wood from the site. On the second area the removal consisted primarily of that portion of the stand that was most desirable for firewood. Half of this area was logged with a small skyline cable yarding system and half with a rubber-tired cable skidder. The degree of site disturbance on these areas was estimated using systematic grids of sample points. Data on two of the case studies were presented in an earlier paper (McMinn 1984).

METHODS

The areas logged are in Floyd and Rabun Counties, Georgia. The Floyd County site is at Berry College northwest of Rome. The Rabun County site is northeast of Clayton on the Tallulah Ranger District of the Chattahoochee National Forest.

The Floyd County site is just below a convex ridgetop and has slopes ranging from 18 to 22 percent. Before the harvest, the volume in trees 5 inches d.b.h. and larger totalled 27.6 cords per acre. Tree species were hickory (Carya spp.), black oak (Quercus velutina Lam.), blackgum (Nyssa sylvatica Marsh.), chestnut oak (Q. prinus L.), shortleaf pine (Pinus echinata Mill.), black cherry (Prunus serotina Ehrh.), white oak (Q. alba L.), black locust (Robinia pseudoacacia L.), yellow-poplar (Liriodendron tulipifera L.), and post oak (Q. stellata Wangenh.). Logging was accomplished with chainsaws and a John Deere 440D[1]/ rubber-tired cable skidder. This machine was a prototype with an 80 horsepower engine, special application axle and transmission, and oversized tires. The model has since replaced the JD 440C, a 70 horsepower machine. The machine did not need the special application package for the harvesting job performed; smaller tires and a lighter axle are standard equipment and would have sufficed on the moderate slopes encountered. All trees in the 5-inch d.b.h. class and larger were felled and limbed, and main stems were skidded in tree lengths to the landing,(fig.1).

On most of the Rabun County site slopes range from 21 to 42 percent (fig 2). The species mix of the original stand included chestnut oak, blackgum, red maple (Acer rubrum L.), white pine (P. strobus L.), scarlet oak (Q. coccinea Muenchh.), sourwood (Oxydendrum arboreum (L.) DC.), northern red oak (Q. rubra L.), hemlock (Tsuga spp.), white oak, hickory, shortleaf pine, and black locust. The total stand volume was 19.4 cords per acre. Trees were felled with chainsaws, but a few were left standing. Logs were bucked prior to yarding and timber removal was limited mostly to merchantable pine logs, hard hardwoods, and a few yellow-poplar. Approximately half the area was yarded with the Bitterroot Miniyarder. This machine is a prototype developed by the Missoula Equipment DevelopmentCenter, USDA Forest Service, Missoula Montana (Domenech 1983). The miniyarder is a lightweight, two-drum skyline yarder that can be mounted on a 3/4 ton pickup truck or, as in our case, a small trailer. It has a live skyline and is powered by an 18-horsepower, 2-cylinder Briggs & Stratton engine. The remaining half of the area was yarded with a 1973 model Timberjack rubber-tired cable skidder with approximately 100 feet of cable. The area was divided up and down the slope so that both yarding systems operated over the entire range of elevation and of stand conditions. Production data for the miniyarder on this area have been presented by Cubbage and Gorse (1984).

Figure 1.--Skidder approaching the landing at the Floyd County site.

Figure 2.--Downslope view of the Rabun County site from the Miniyarder deck.

Figure 3.--Soil disturbance on the Floyd County site.

The Total Biomass Cruise Program was used to estimate timber volumes (Clark and Field 1981). Initial conditions on the study sites and volumes removed in logging are shown in Table I. After logging, the areal coverage of soil disturbance was estimated on both sites from a systematic grid of points covering the area associated with each yarding system. A baseline was estab-

[1]/Use of tradenames is solely to identify equipment used and does not constitute endorsement by the USDA Forest Service.

lished bisecting each area and running up and down slope. At intervals along the baseline transects were run in both directions perpendicular to the baseline (roughly along the contour) and to the edges of the logging area. The transect intervals were 20 feet for the Floyd County site and the Rabun miniyarder area. Those data indicated that sampling intensity could be halved, so intervals were 40 feet for the Rabun County cable-skidder area. Sample points were spaced at 5-foot intervals along the transects resulting in a minimum sample-point density of approximately 1 point per 200 square feet. Each point was observed for classification into one of the following three disturbance categories:

Undisturbed (U)--original duff or litter still covering the mineral soil.

Exposed (E)--litter and duff scraped away exposing mineral soil, but with no scarification.

Disturbed (D)--mineral soil exposed and scarified or dislocated. Haul roads and log yards were excluded from the estimates of area disturbed.

RESULTS AND DISCUSSION

The miniyarder clearly caused substantially less site disturbance than the rubber-tired cable skidders. The percentage of each of the logged areas in each disturbance class is shown in Table 2.

Operating on a relatively moderate slope, the cable skidding exposed mineral soil on 37 percent of the Floyd County logging area. On 25 percent of the total area the disturbance was severe enough to scarify or dislocate the soil. These results are consistent with findings in a whole-tree harvesting study on slightly more moderate Upper Piedmont slopes where all material 4 inches d.b.h. or larger was removed (McMinn 1983); mineral soil exposure there was 30.3 percent in summer and 34.7 percent with winter logging. Skidder disturbance was distributed fairly uniformly over the logging area (fig. 3). Operators on the Floyd County site had no prior experience with the equipment and appeared to perform a number of unnecessary maneuvers. Experienced operators would have been more efficient, and might have caused less soil disturbance.

Cable skidding on the Rabun County site disturbed only 16 percent of the area even though the average slope was twice as steep as the Floyd County site (table 1). Not all of the difference in disturbance between the two areas can be attributed to the volume removed, because the area exposed was 1.34 and 1.19 percent per cord per acre for the Floyd and Rabun sites, respectively. Neither can the difference be attributed to timber size, because the size class distributions for timber removed was similar for the two areas (table 3).

Table 1.--Summary of initial conditions and volumes removed for fuelwood harvesting areas in Floyd and Rabun Counties, Georgia

Characteristic	Logging area	
	Floyd County	Rabun County
Slope (percent)	18-22	21-42
Stand volume (cords/acre)		
Pine	4.7	2.8
Hard hardwood	21.0	10.7
Soft hardwood	1.9	5.9
Total	27.6	19.4
Volume removed (cords/acre)		
Pine	4.7	2.8
Hard hardwood	21.0	10.7
Soft hardwood	1.9	0.0
Total	27.6	13.5

Table 2.--Soil disturbance by location and yarding system for two mountain firewood harvests in north Georgia

Location	Yarding system	Disturbance class		
		U	E	D
County		- - - Percent - - - -		
Floyd	Cable-skidder	63	12	25
Rabun	Cable-skidder	84	7	9
Rabun	Miniyarder	99	1	0

Table 3.--Percent diameter distribution for 27.6 cords per acre of material removed in Floyd County and 13.5 cords per acre of material removed in Rabun County

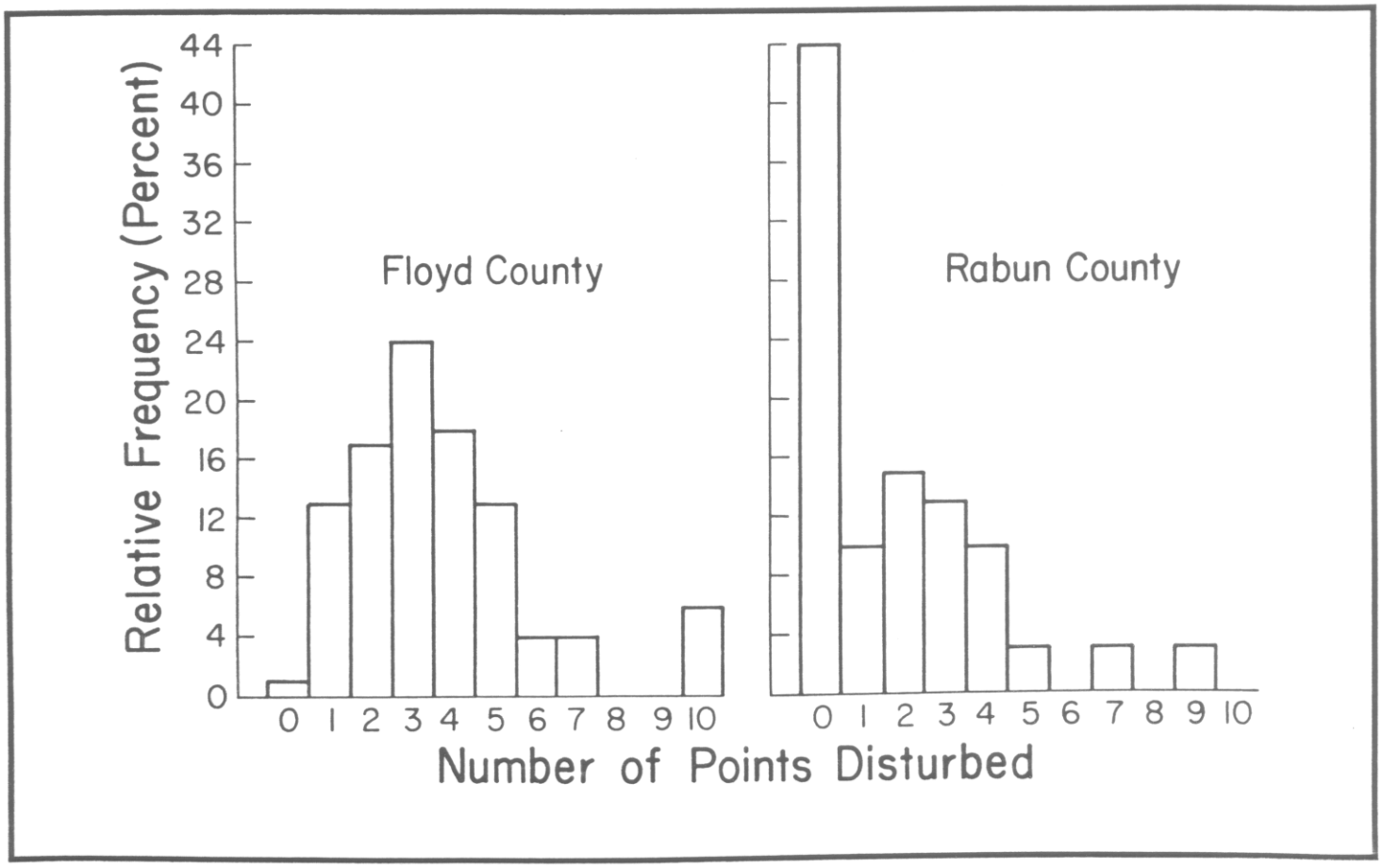
Diameter class	Logging area	
	Floyd County	Rabun County
Inches	- - - - - - Percent - - - - - -	
5	14.8	12.3
6	11.1	9.3
7	13.6	16.7
8	14.8	13.2
9	10.5	8.2
10	8.6	13.2
11	8.0	8.6
12	4.9	4.6
13	3.1	5.2
14	3.7	4.1
15	3.1	2.0
16	1.2	2.1
17	1.2	0.0
20	0.6	0.0
22	0.6	0.0
23	0.0	0.5

Operator experience probably accounts for some of the difference, but another factor appeared to have an influence. On the Rabun County site cable skidder travel was confined almost exclusively to defined skid trails (fig. 4), which covered a very small proportion of the area. In contrast all of the Floyd County site was easily traversible by the cable skidder. The two operations resulted in very different patterns of disturbance as evidenced in figure 5, which presents frequency distributions for the number of sample points exposed or distrubed when the transect data are partitioned systematically into ten-point clusters. The Floyd County site resulted in a fairly symmetrical frequency distribution: a very small proportion of of clusters had no points affected. The Rabun County site exhibited a heavily skewed distribution with 44 percent of the clusters having no affected points and no clusters having all points exposed or disturbed. This leads the author to speculate that, on slopes moderate enough to be easily traversible, soil disturbance will generally increase with slope. However, there will be some threshhold slope value at which the area of soil disturbance will decrease because skidder travel is confined to specific corridors.

Figure 4.--Skid trail on the Rabun County site.

From a practical standpoint the skyline logging system caused no disturbance even though the slope was steep, and the operator had never used a cable system before. Out of a total of 619 sample points 610 were undisturbed, 8 had exposed mineral soil with no scarification or dislocation, and only one point had exposed, scarified soil. As might be expected, the 9 points exhibiting some disturbance were along the two skyline corridors where there were repeated opportunities for disturbance by logs swinging close to the ground. The very good performance of this system from the standpoint of site disturbance indicates that research and development should continue on equipment design and operational techniques to render such systems productive and economical. One of the major benefits to be gained is a tremendous increase in the effective supply of a potentially valuable resource.

Figure 5.--Relative frequency distributions for the number of points exposed or disturbed per 10-point cluster on fuelwood harvest areas in Rabun and Floyd Counties.



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